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AIR WAR COLLEGE

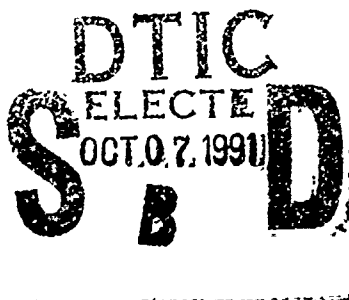
RESEARCH REPORT

PROPOSED AUTOMATION AND SOFTWARE MANAGEMENT STUDIES

FOR THE AIR WAR COLLEGE CURRICULUM

(CORE AND ADVANCED STUDY)

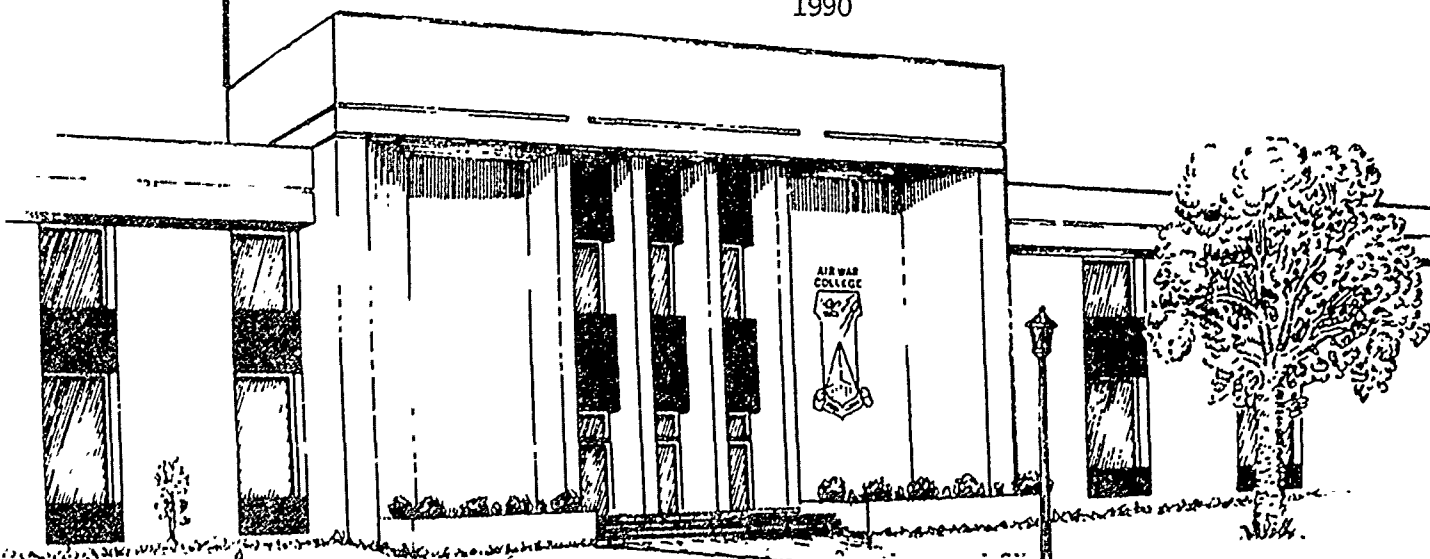
JUSTIFICATION AND METHODOLOGY



91-12325

LIEUTENANT COLONEL BERNARD K. SKOCH

1990



AIR UNIVERSITY
UNITED STATES AIR FORCE
MAXWELL AIR FORCE BASE, ALABAMA

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PROPOSED AUTOMATION AND SOFTWARE MANAGEMENT STUDIES
FOR THE AIR WAR COLLEGE CURRICULUM
(CORE AND ADVANCED STUDY)
JUSTIFICATION AND METHODOLOGY

by

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A DEFENSE ANALYTICAL STUDY SUBMITTED TO THE FACULTY
IN
FULFILLMENT OF THE CURRICULUM
REQUIREMENT

Advisor: Colonel Douglas B. Cairns

MAXWELL AIR FORCE BASE ALABAMA

May 1990

EXECUTIVE SUMMARY

The Air Force has thousands of computers, and will have spent in seven years over \$17 billion on them. In the future, leaders will need the benefits of automation more as they seek improved efficiency. Software is a similarly important topic; every major weapon system the Air Force buys has software as a major component. Yet the Commander of Air Force Systems Command has said correctly that not a single major software development program has been delivered in time.

But no core curriculum at the Air War College is devoted to either of these vital areas. And although an elective (Advanced Study) was offered in 1989-90, it was narrow in scope.

This paper proposes changes: first, including in the core course of study a lecture by (and question and answer period with) the Air Force Assistant Chief of Staff, Systems for Command, Control, Communications and Computers and a two-hour long seminar dealing with the vital issues of automation and software; and second, refocusing the elective (Advanced Study) offered by the College to include a broader range of topics (the Importance of Computers, the Software Problem, Requirements, Standard Systems, C2 Systems, Mission Support Systems, Requirements Contracts, Base/Wing-Level Automation, Information Architecture, and the Future of ADP in the Air Force).

TABLE OF CONTENTS

Overview.....	1
Computers Everywhere.....	2
The Cost of Computers.....	3
The Benefits.....	5
Software.....	7
Education at Air War College.....	10
The Cost.....	12
The Method.....	13
The Elective 1989-90.....	14
A Proposed Elective Advanced Study.	16
Prerequisites.....	23
Summary.....	24
End Notes.....	26



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OVERVIEW

Computer systems and software have become critical to the ability of the Air Force to do its job. Every major weapon system today relies on computers for a broad array of functions. Additionally, the Air Force has become extraordinarily reliant on computer systems for mission support: personnel, finance, transportation, medical information, services, etc. And small "personal" computers are invading Air Force work centers in large number.

As pervasive as these systems are, they are not easily understood. They are in themselves technical, complicated, and sophisticated. Worse yet, even acquiring these systems is a complicated and technical process not easily understood by the system users.

Ironically, as critical and pervasive as these systems have become to our ability to fly, fight, and win, senior Air Force leadership is taught little of how to acquire and manage these systems for their benefit or of the importance of software development. Instead, they must rely on computer "techies" to plan, acquire, install, manage, and maintain their vital systems.

This paper will describe the pervasiveness of computers in the Air Force and will define why educating senior, and future

senior, Air Force leaders on them is so important. It will describe how that education has taken place in the past and why it is inadequate as presently administered. And it will propose a solution: including the study of automation as a topic in the Air War College core curriculum, and improving the single elective (advanced study) course offered at the College.

COMPUTERS EVERYWHERE

Computers have pervaded the Air Force. By 1985, over 30,000 standard small computers had been ordered under the standard small computer requirements contracts.¹ By 1988, the Air Force had a small computer for every three and a half people in its force. Additionally, the Air Force is acquiring numerous large automation systems. The Personnel Concept III system will be installed at each and every Air Force installation worldwide at a cost of over \$150 million. The Logistics Management Systems (LMS) Modernization program will automate logistics functions worldwide. And automated finance systems will improve accounting and finance services for Air Force members everywhere.

All of this automation is changing the way the Air Force does business. But not all of the news is good. The larger Air Force automation programs are drawing attention the Service doesn't want or believe it needs. For example, the LMS

Modernization Program, a collection of "smaller" automation programs, was brought before the Government Accounting Office for discussion in 1988 as a topic of discussion because three of its ten or so component programs had grown in aggregate cost from an originally estimated \$259 million to \$564 million in September 1988.² And earlier in that decade, Air Force failure to correctly manage the acquisition of automated logistics systems resulted in a decree from committees of both houses of the Congress that any logistics computer system being acquired by other than full-and-open competition requires the approval of those committees. As of this date, the Air Force has not yet received relief from that requirement.³ The Air Force is receiving the attention of other Federal agencies, and "help" it doesn't want in acquiring computer systems.

THE COST

More important than the attention our automatic data processing (ADP) acquisitions are drawing, however, is the resources we are spending on them. The following table depicts Air Force expenditures, both actual and estimated, on ADP for fiscal years 1985 to 1991:

<u>YEAR</u>	<u>EXPENDITURES^a</u>
1985	\$2,466,854K
1986	\$2,433,977K
1987	\$2,652,847K
1988	\$2,457,204K
1989	\$2,561,039K
1990	\$2,601,221K (Estimated)
1991	\$2,658,679K (Estimated)
TOTAL	\$17,831,821K

(\$K=Thousands of Dollars)

It is important to note that these figures reflect only non-embedded systems, that is those that are separate and distinct from a weapon system. Flight control computers in aircraft, guidance systems in missiles, navigation systems, maintenance systems, and similar computers that are tied directly to weapons systems are not included in this figure.^a

So, the Air Force has spent, or intends to spend over \$17.8 billion (with a "b"!) on automation over a seven year period. Consider what that money could do. It could fund over 63% of the balance of the entire B-2 Stealth bomber fleet. Or it could fund the estimated construction cost of \$400 million for the beddown

of the B-2 about 40 times over. At \$50 million per copy, it could buy 356 tactical fighters! By any standard, this investment is sizeable, and it represents a significant, measurable portion of the Air Force budget.

THE BENEFITS

No one could argue that the Air Force doesn't gain significant advantage from its investment in automation. Probably the most dramatic examples are in lethality of weapon systems. Computer systems make weapons more accurate, and therefore more lethal. And in the area of logistics, computers allow thoughtful planning for spares, and allow shipping and supply of parts in a way that is far more cost effective. The LMS program will result in more aircraft and missiles being "up" than ever before, because it will reduce the times those systems are inoperative because parts weren't available when and where required.

In the area of manpower, computers allow the Air Force support functions to literally do more with less. Consider the Personnel Concept III program being acquired as this is written. The installation of that system will cost about \$157 million. But it will obviate the need for 1,537 manpower spaces in Air Force consolidated base personnel offices worldwide.^o And it

will make the lives of Air Force people easier too. No more will they need to trudge across the base to update a "dream sheet". Nor will they need two hours to obtain a new identification card or a meal card for use in dining facilities. Instead, they will have at ready access all of those functions and more.

The point is, that for its sizeable investment in ADPE, the Air Force is deriving sizeable benefits. So embodied in automation systems we have an area which: (1) Is pervasive in the Air Force to the extent that it is involved in every single weapon system and touches the life of every single Air Force member; (2) Is consuming resources in the amount of about \$2.5 billion each year, not including embedded computer systems; and (3) Is deriving enormous benefits for the Air Force in terms of manpower saved, missions flown, aircraft and missiles available, and the quality of life for Air Force people. Yet an analysis of the amount of attention given the area of automation in the education of senior Air Force officers reveals a startling fact: No time is devoted to it in the preeminent Air Force school for senior officers--the Air War College. It is remarkable that a topic of such importance to the Air Force would receive such little (none!) core curriculum attention in such an important course in an officer's career.

SOFTWARE

A related, but somewhat distinct topic is software. As General Bernard P. Randolph, then commander of Air Force Systems Command said, "We've got a perfect record [with software scheduling]...we've never made one on time yet!"⁷ And civilian publications have frequently criticized the military's inability to generate usable software in time, attributing to it the qualities of "vaporware", a derogatory term ascribed to commercial software which has the qualities of vapor: invisibility, a lack of persistence, and unpredictability.⁸ And in its editorial of October 17, 1988, Aviation Week magazine criticized U.S. military leaders because "software development for weapons systems is not receiving enough attention from [those leaders]."⁹ And the respected Gary Chapman, executive director of Computer Professionals for Social Responsibility said that "Reliable software is the number one headache in the military."¹⁰ Software development problems have been blamed for delays and cost overruns in the fielding of many weapon systems, including the B-1B, the B-2, and the C-17.

Software intensive systems, that is, those which rely very heavily on software for their proper operation, exist throughout the Air Force. Some of the them are listed here:¹¹

EF-111A Update	JTIDS
F-4G Update	JSTARS
B-1B Defensive System	Granite Sentry
F-15E	GDSS
F-16C/D	AFC2S
AWACS	WWMCCS
ATF	LMS
B-2	MILSTAR
C-17	SDI
SWPS	

This "alphabet soup" of acronyms represents nearly every major program in which the Air Force is now engaged. Indeed, software is everywhere.

And software is becoming more complex. In 1965, the F-111 was considered, in its development, as a computerized wonder. Indeed, it had on-board about 100,000 "words"¹² of computer software. By 1985, however, the software being developed for the F-16 C/D (the "simple" jet, remember?) occupied over 1,000,000 words of memory. And the Advanced Tactical Fighter is expected to have over three times that amount, nearly 3,200,000 words of software--over 30 times that in the F-111 of just 25 years ago.¹³ And though the prospect of our fielding a full-up Strategic Defense Initiative appears to be waning, it is instructive to note that the Congressional Office of Technology

Assessment predicted in 1988 that the system could never possibly work because "there would be a significant probability that the first time the ballistic missile system were used in a real war, it would suffer a catastrophic [software] failure."¹⁴

And more, smaller software development issues are eating away at Air Force efficiency. In a subtle way, Air Force units are spending inordinate time learning how to use software to do their jobs. Many members spend hours writing programs for use on the personal computer systems the Air Force provides them, paradoxically using their valuable time to try and save valuable time. Regrettably, however, that software may not work, or that software may already exist in another unit. But because no coordinated and enforced way of cataloging software exists, Air Force people frequently "re-invent the wheel", spending precious man-hours developing software that has been developed already.

The very senior Air Force leadership has recognized the need for educating general officers on the issue of software management. In 1985, then Secretary of the Air Force Verne Orr and Air Force Chief of Staff General Charles A. Gabriel sent a memo to all major commanders and separate operate activity commanders saying the following:

"Air Force operational readiness can be improved through increased... understanding...of the dominant role

software plays...Towards that end, we are
initiating a software management course
for general officers"¹⁵

In penning that memo, the Secretary of the Air Force and Chief of Staff created a course called "Bold Stroke" which is taught to Air Force general officers at Maxwell Air Force Base. It is a good initiative which has added tremendously to the understanding and appreciation of the software "problem" by general officers. But is that attention focused where it should be? Although software is an important issue for the very senior Air Force leadership (general officers), isn't it also the case that senior officers in the lieutenant colonel and colonel grades should also be educated on this vastly and critically important area? Isn't it true that it is the colonels and lieutenant colonels who will be the general officers of tomorrow? And don't colonels need an appreciation of software even more extensive than that of general officers since it is they who will acquire and manage systems at a greater level of detail than their general officer leaders?

EDUCATION AT AIR WAR COLLEGE

It is clear that computers and software are key and extensive components in the Air Force. Senior leadership

believes strongly enough in their importance to justify sending each general officer to Maxwell Air Force base at least once to receive the several-days-long "Bold Stroke" course. That course is taught at some expense. It is only reasonable to expect that students in the Air War College should receive similar education. And doing so would provide several distinct advantages:

- First, the education would be given to a broader base of Air Force leaders than can be Bold Stroke. There are 164 Air Force¹⁶ officers in the Air War College Class of 1990.¹⁷ Those are 164 Air Force leaders who could benefit greatly from such an education.

- Second, the topic of computers and automation per se (as distinct from Bold Stroke, which discusses and teaches only the software issues) is never taught to either general officers or colonels outside the training given automation professionals in the service. Devoting a few hours to the subject in the AWC curriculum would be the only exposure given to many officers.

- And third, educating senior officers on the topic would undoubtedly enlighten those officers to the problems of automation and make them more

capable of doing their jobs more efficiently and of using automation to help them do their jobs as senior leaders better.

THE COST

The cost of the education would be minimal. Although curriculum time at the college is valuable (and expensive), readjusting the curriculum to accommodate a minimal one-hour lecture, one-hour discussion, and a two-hour seminar would not add significantly to the cost of the curriculum. Further, with frequent revision of the curriculum, the subject of automation and software could surely displace a lower priority "day" of education at the school. And, tangentially, surely the great changes that have been and are sweeping the world have changed what education is necessary at the school this year. Could a case not be made that one less day on the TWX exercise would have minimal impact on the students' education on warfighting? Is it not possible that, important as they might be, Soviet Studies might be reduced by just four hours to allow time for this important education?

THE METHOD

It would be naive to suggest that more than a few hours could be spared for such an endeavor. Accordingly, the following curriculum is proposed:

- First, a one-hour lecture by the Air Force Assistant Chief of Staff, Systems for Command Control Communications and Computers. The lecture would address automation challenges facing the Air Force; how the Air Force is structured to meet its automation needs; the costs of automation; the benefits of automation; and the software "problem". The incumbent, Brigadier General (Major General selectee) Albert J. Edmonds has agreed to give such a lecture if asked.¹⁰

- Second, a one-hour question and answer session by the General. Students will undoubtedly wish to solicit his views on the cost of automation to the Air Force, its effectiveness, its opportunity costs, why the Air Force buys the systems it does, etc. And undoubtedly, in a one-hour lecture, the General will not be able

to cover any specific topic in depth. A question and answer period will allow him to explore in more depth topics of particular interest to the class.

- Third, a two-hour seminar in which students could share their experiences and glean from one another views on why automation is so important and on what frustrations they have experienced in fielding and using automated systems. This seminar could be student- or faculty-led, depending on the expertise of the seminar group.

This curriculum, which would be given all Air War College students, would go a long way toward educating future Air Force leaders on computer and software issues. But a need exists to educate a few students on a more in-depth scale on particular automation issues. For this purpose, an effective advanced study course should be offered by the College.

THE ELECTIVE 1989-90

The Air War College has recognized the need for some education on automation issues. It has included in its "elective" course offerings an advanced study titled "Information

Management Systems for Senior Leaders". The course was well received by the students enrolled in academic year 1989-90. It did, however, suffer from some shortcomings beyond the control of the AWC faculty which administered the course.

The course was intended to cover a broad range of topics, as the following course description explains:

"This course is designed to introduce the senior manager to the world of management information systems (MIS) planning, implementation, and management. The course will take the senior executive on a tour of computers, software, planning, networks, and future trends in MIS in order to provide the background for making sound decisions in the use of computing resources at the wing level and beyond. Of most importance in this course will be actual conversations with MIS implementors and managers in many of the functional communities across the Air Force. Featured will be an opportunity to visit the Computer Systems Division (CSD) and Standard Systems Center (SSC) and discuss particular desires and needs with information system professionals who are working on the systems of today and tomorrow."¹⁰

The course clearly intended to address a broad range of topics, but regrettably, it did not. Instead, in implementing the course, Standard Systems Center (SSC) and Computer Systems Division (CSD) participants in planning the course focused almost entirely on their perspective and their role in managing ADP systems. As a consequence, students enrolled in the course heard more about SSC and CSD projects and initiatives than they heard of broader topics, more important to their learning.

It is worth noting at this point that these criticisms are not intended to impugn the expertise of those who presented the course or their intentions. In fact, they were remarkably well informed, insightful in their presentations, and desirous of presenting what they viewed as best for Air War College students. But they simply didn't know where to focus their attention.

A PROPOSED ELECTIVE ADVANCED STUDY

The 1989-90 elective forms a sound basis for an improved one. But fundamental topics must be added. The author, in coordination with the Air Staff, the Air University Deputy Chief of Staff of Communications and Computer Systems, and the Technical Director of the Standard Systems Center, improved the

curriculum to make it more reflective of what senior leaders and future senior leaders of the Air Force need to know.

Accordingly, the following topics for classes are proposed:

Importance of Computers, Budget, Funding,
Acquisition, Management, Major System Acquisition,
Legislative/Congressional Constraints, and the
Distinctions Between Embedded and Non-Embedded
Systems (and the Critical Aspects of Each)

The Software Problem/Bold Stroke Briefing/Software
Development Technologies

Requirements--What are they? Who Develops them?
How are they met?

Standard Systems--What are they? Who uses them?
How are they acquired?

Command and Control Systems--Major Systems, Users,
Applications, Costs

Major Command Systems--Major Systems, Users,
Applications, Costs

Requirements Contracts--History, Development,
Current, Likely Future

MAJCOM/Base-Level ADPE Systems & Support

Information Architecture--What, Why, How? Who?

Future of ADPE Technology, Especially AF Applications

This proposed curriculum goes much farther in addressing the needs of present and future Air Force future leaders. Although there exists some commonality with what was presented the previous academic year, what is proposed here goes beyond that. The following is a brief discussion of each session and how it will benefit the students (those preceded with the annotation '***' were presented during academic year 1989-90):

Importance of Computers, Budget, Funding, Acquisition, Management, Major System Acquisition, Legislative/Congressional Constraints: Certainly at the core of any understanding of computers to future Air Force senior leaders is an appreciation for their pervasiveness. And since the Air Force is constrained by the Congress, the General Services Administration, the Office of the Secretary of Defense and others in the way it acquires computers, an understanding of those constraints is imperative to an appreciation for the computer acquisition process. Additionally, the distinction must be drawn between embedded and non-embedded systems, and the critical aspects of each

identified. This presentation will be made by the commander of the Computer Systems Division, Brig Gen Webber, at the Computer Systems Division Headquarters on Gunter Air Force Base.

**** The Software Problem/Bold Stroke Briefing/Software Development Technologies:** As was done last year, a review of the Bold Stroke course will significantly improve students' understanding of the software "problem". The briefing is structured in such a way that it conveys the pervasiveness of software in today's Air Force, its complexity, the reasons developing software is so difficult, and what Air Force software development activities are doing to grapple with those problems. It will be presented by the director of the Bold Stroke course at the Bold Stroke facility.

Requirements--What are they? Who Develops them? How are they met?: Possibly the most misunderstood aspect of computer systems is the fundamental question of what constitutes an automation "need", and how needs are communicated to planners and system acquisition people. This session, to be presented by personnel from the requirements branch of the Standard Systems Center, will provide an understanding of requirements at all levels, but in particular at the major command and Air Force levels.

Standard Systems--What are they? Who uses them? How are they acquired?: A senior leader in the Air Force will have most

contact with what are called "standard" ADP systems--those that are in use at more than one major command, including personnel, accounting, services, and similar systems. This session, presented by system managers at SSC, will define what those standard systems are and will give a detailed explanation of one to provide an understanding of how those systems are developed, acquired, installed, maintained, and operated.

Command and Control Systems--Major Systems, Users, Applications, Costs: Critical to our effectiveness as a fighting force is an ability to command and control our weapons and people. Command and control in today's dispersed and rapidly changing fighting environment would be impossible without command and control automation systems. This session of the advanced studies course will provide an understanding of those systems and will give the students an appreciation of the criticality of system control in those ADP systems. It will be presented by system managers at the SSC.

Major Command Systems--Major Systems, Users, Applications, Costs: Each major command has its own unique set of problems which are best solved with well planned, acquired, and managed automated systems. This session will be presented by system managers at the SSC and will provide the student with an understanding of how those systems are planned, acquired, and managed.

**** Requirements Contracts--History, Development, Current, Likely Future:** Personal computers are in use in the Air Force in enormous number. They have simplified information management for thousands of people, and they have made rapid access and manipulation of information available like never before. The Air Force, through its mandated competitive acquisition process, has fielded a family of systems which use the MSDOS operating system. Many users complain that this family of computers is too difficult to learn to use and too cumbersome to use. This session of the advanced study will provide valuable insight into how the Air Force acquires those systems and why those selected were selected. It will provide students with an understanding of when requirements contracts must be used, and how users can meet needs not suitably met by systems from those contracts. The Air Force manager of small computer requirements contracts will present this session.

MAJCOM/Base-Level ADPE Systems & Support: The most frequent contact a wing commander will have with an individual responsible for automated systems will be with his or her computer-communications staff officer. Further, the most frequent contact a member of a major command staff will have is with that MAJCOM's deputy chief of staff (DCS) for communications and computer systems. Air University, because its two installations are located in close geographic proximity, has a single individual serving in both those capacities. He has

agreed to present a session on what his roles are, how he serves the needs of his host wing and his major command, and what the students, as future wing commanders and major command staff officers need to know to best utilize computer staff officers and their services at wing and major command level.

Information Architecture--What, Why, How? Who?: The principal purpose of automated systems is to help leaders, managers, and members of the Air Force better acquire, store, manipulate, communicate, and retrieve information. Yet few Air Force members understand what information really "is", or how it is structured in the Air Force. This advanced studies session will provide that understanding.

Future of ADPE Technology, Especially AF Applications: One of the marvelous qualities of ADP technology is the fact that it advances so quickly. No study of ADP would be complete without exposure to and familiarization with the changes in that technology as they appear on the horizon. This session will provide a glimpse of what the future will hold and in particular what the future holds for Air Force systems. It will be presented by the technical director of the Standard Systems Center.

This curriculum for the advanced studies course far better represents the needs of future Air Force leaders and provides a view of key ADP issues which transcends the SSC or CSD

perspective.

PREREQUISITES

Last year's advanced study had no prerequisite.²⁰ That was intended, of course, to solicit for course attendance students who had a broad range of experience and qualifications and to avoid excluding any interested student. That was, and remains, a good policy. However, an "exclusion" should be added. During the 1989-90 elective class, several students enrolled who were ADP professionals.²¹ Unfortunately, their presence appeared to suppress on occasion discussion on the part of non-ADP oriented students. Further, the discussions often pursued highly technical lines to the detriment of discussion of broader, more fundamental (and more germane to future wing commanders) topics. Accordingly, a prerequisite for the 1990-91 course should be that students who are (or have been recently) involved in managing ADP systems not attend the course. A discussion with those who have agreed to present sessions next year in the elective course (SSC and CCD representatives, the Air University DCS for communications and computer systems, and the Bold Stroke representative) agree that this policy should be implemented.

SU ARY

Automation has become a significant factor in the way the Air Force does business and fights. Computers are found on every Air Force installation, providing key planning and support functions. Yet the Air War College has devoted no curriculum time to the analysis and assessment of their application by the Air Force.

Similarly, software is now a vital component of modern weapons systems. And management (or, more appropriately, mismanagement of software) is bringing great criticism to the Air Force and delaying the delivery of critical new systems. Yet again, no curriculum time is spent at the College in the study of this situation.

What has been proposed here will correct that situation. First, by including in the core curriculum some study of both automation and software, future senior leaders in the Air Force will be better able to manage automation systems by knowing how to manage their automation resources and to make best use of the systems they have. And second, by gaining an appreciation for the magnitude of the use of software in Air Force systems and the complexity of that software.

And for those students concerned that their future as senior leaders and managers will confront them with automation and software issues, a restructured computer-systems oriented advanced study will allow them to receive even more instruction in and exposure to the complexities of automated systems. They will receive a far broader education in the significance of automation, requirements definition, major systems, and the future of ADP technology in the Air Force than was presented in academic year 1989-90.

As a result of implementing these changes, the future leaders of the Air Force will be better able to lead it into the intensely technical world of the coming decade.

¹ Skoch, Bernard K., "Small Computer Management", AU Press, 1987, p.17.

² Grossman, Lawrence C., "Automation Altercation", Government Executive, October 1989, p.43.

³ The author spent three years on the Air Staff as the focal point for obtaining those approvals from 1986 to 1989.

⁴ Headquarters United States Air Force SCP 8901 Report, Automatic Data Processing Management Information Systems Report, HQ USAF/SCP, The Pentagon, 1990.

⁵ The reason for not including embedded systems may not be obvious to the reader. It is, quite simply, because nowhere does there exist a means of measuring the costs of embedded systems. they are so inextricably tied to the costs of modern weapon systems that there is no way to break them out from the costs of the weapon itself.

⁶ Personnel Concept III Major Automated Information System Review Council (MAISRC) Documentation Package, HQ USAF/SCM, 1989.

⁷ McBride, Lt Col Dorothy J., "AFIT Tackles the Software Problem", Air Force Magazine, December 1989, p.80.

⁸ Savage, J.A., "Longing for Warware", ComputerWorld, October 16, 1989, p.23.

⁹ Editorial, "Achilles Heel", Aviation Week, October 17, 1988, p.15.

¹⁰ Savage, J.A., "Can Military Software Pass Muster?", Business and Society Review, Winter 1990, p.22.

¹¹ "Bold Stroke" Briefing, 1989, Air Force Center For Professional Development", Maxwell Air Force Base, Alabama.

¹² A "word" is a unit of computer memory which describes a standard segment of data. Unlike a lingual "word" however, a computer "word" can refer to a single character of information.

¹³ "Bold Stroke" Briefing, 1989, Air Force Center For Professional Development", Maxwell Air Force Base, Alabama.

¹⁴ Betts, Mitch, "Complexity of Battle Software Would Doom SDI in Actual War", ComputerWorld, June 13, 1988, p.19.

¹⁵ SECAF/USAF/CC Memo to AJMAJCOM-SOA/CC, 15 October 1985.

¹⁶ This figure includes Air National Guard and Reserve officers.

¹⁷ Air War College Student Roster, 24 August 1989.

¹⁸ General Edmonds agreed to do so, if asked, in a telephone conversation with the author in April 1990. The call was not made as though by a representative of the Air War College, but instead by his former executive officer.

¹⁹ Course Instructors Guide, "Information Management for Senior Leaders", AWC/DFL, 1989.

²⁰ Ibid.

²¹ The author included!

Title: Computers and Software--The Challenges of Acquiring, Using, and Managing Them

Introduction: The Air Force could not function today without computers. They are embedded in every major weapon system, performing control, targeting, arming, warning, and maintenance functions. They are the whole basis of our strategic warning systems, and they form the backbone of our command, control and communications systems. Mission support systems have significantly improved the efficiency of support organizations. For example, the Personnel Concept III automation program, which will reduce workloads in CBPOs and orderly rooms in active, guard, and reserve units worldwide, will significantly improve service to Air Force members, but will reduce the need for personnel manpower by over 1,500 authorizations. Further, the Logistics Management System Modernization program will improve the ability of logistics organizations at every Air Force installation and every headquarters at every level to provide the logistics support and information Air Force leaders need.

Computers are here in a big way. But not all agree that the Air Force approach to automation has been without its drawbacks. For example, some argue that the Air Force is spending too much on automation. Others point out that the Air Force acquisition of computers is so cumbersome that it delivers old technology. Others complain of a cumbersome requirements development process that doesn't deliver what the user really needs, but instead provides what's cheap and available. And in the work centers of the Air Force, some complain that personal computer systems the Air Force acquires are "unfriendly" and difficult to use. And worse, the software on which all automated systems are inextricably dependent has been a source of weapon system acquisition delays, cost overruns, and delivered systems which do not meet the users' needs.

The readings for this period address some of those criticisms. The lecture will do likewise, and will provide the perspective of a senior Air Force leader who has been involved in many aspects of computer systems at wing, numbered Air Force, and Air Staff level, as well as in the Joint environment. But most important to this period are the perspectives of the students--their frustrations, failures, and successes in acquiring and using automation to solve problems.

Objective: Comprehend the pervasiveness of computers in the USAF primary and support missions, and analyze the strengths and deficiencies of AF practices for developing requirements and acquiring, maintaining, and employing automation systems.

Desired Learning Outcomes:

1. Identify who is responsible for developing automation requirements and how those requirements are developed.
2. Appraise the success of competition advocacy in USAF computer system acquisition.
3. Characterize the USAF software "problem" and recommend remedies to defuse that problem.

Seminar Preparation:

The readings for this period have been gleaned from a variety of sources. You will notice that one of them regards other-than-Air Force automation initiatives. That's for a good reason. Much of what the Air Force wrestles with in the acquisition of computer systems, the civilian world does as well. Four of the readings deal explicitly with the Air Force software "problem", the situation in which we find ourselves more and more reliant on software, but more and more frustrated in producing the effective software we need on time or under budget. Project into the readings your experiences with automation in the military. The Supplemental Reading is a primer on computers, and covers a broad societal perspective. If you are comfortable with the pervasiveness of computers and don't suffer "technophobia" at the mention of them, you may wish to skim the reading or ignore it altogether. But if you think there might be some holes in your basic understanding of them, you might want to read it; it's short. Most of all, pay attention to the lecture. Though a communications-computer professional, this leader has seen automation requirements and development at all levels, in peace and wartime, and has a remarkably "user-sensitive" view of the world. He will provide you with a candid assessment of where we are in automation, what's broken in the way we do business, and what it will take to fix it.

Assigned Readings:

1. Davenport, Thomas H. et al, "How Executives Can Shape Their Company's Information Systems", Harvard Business Review, March-April 1989, pp. 130-134.
2. Grossman, Lawrence C., "Automation Altercation--A GAO Report raises serious questions about the way the Pentagon manages the acquisition of major automated information systems, and Congress is asking for changes", Government Executive, October 1989, pp. 42-46.
3. Editorial, "Achilles Heel", Aviation Week and Space Technology, October 17, 1988.
4. Savage, J.A., "Longing for Warware", ComputerWorld, 16 October 1989; "Can Military Software Pass Muster?", Business and Society Review, Winter 1990.
5. Betts, Mitch, "Complexity of Battle Software Would Doom SDI in Actual War", ComputerWorld, 13 June 1988.
6. McBride, LtCol Dorothy J., "AFIT Tackles the Software Problem", Air Force Magazine, December 1989, pp. 80-82.

Supplemental Reading:

Mediate, Christina et al., Computers and the Information Society, pp. 2-24.

Title: Computers and Software--The Challenges of Acquiring, Using, and Managing Them

You and your seminar mates will have just finished listening to a lecture and participating in a question and answer period with a computer professional from the Air Staff. That experience, combined with the readings, and, most importantly, your own experiences, will give you some basis for discussion of key automation issues facing the Air Force today. What follows are suggested topics of discussion. Do not feel constrained by them, but do try to at least touch on all of the issues.

Objective: Comprehend the pervasiveness of computers in the USAF primary and support missions, and analyze the strengths and deficiencies of AF practices for developing requirements and acquiring, maintaining, and employing automation systems.

Desired Learning Outcomes:

1. Identify who is responsible for developing automation requirements and how those requirements are developed.
2. Appraise the success of competition advocacy in USAF computer system acquisition.
3. Characterize the USAF software "problem" and recommend remedies to defuse that problem.

Seminar Preparation:

You have noticed that the readings for this instructional period are in two distinct groups.

The first grouping, the Davenport and Grossman articles (Assigned Readings 1 and 2) deal with the generalities of requirements definition, the involvement of senior leaders in managing their automation systems, and with the sometimes-unwelcome scrutiny the Department of Defense receives from Congress and others on its automation systems.

The second grouping, the Aviation Week and Space Technology editorial, the Savage articles, the Betts piece, and Colonel McBride's article (Assigned Readings 4-7) deal with the software "problem".

Your time will be very limited. We suggest that you assign a seminar member to read in detail Readings 1 and 2, and provide a short (5-10 minute) presentation on what they contained, and a perspective on the following question:

"How did the Department of Defense not apply the concepts in the Davenport article to its major systems (described in the Grossman piece)?"

Then we suggest you devote the balance of your time to discussing the following questions:

1. Why is the software "problem" so acute?

When you discuss this question, see if you can identify the root causes of the "problem" (complexity of weapon systems, the type of programming we do, people problems [training, recruiting, retention, etc.], unrealistic expectations, etc.). You might want to discuss whether or not our problems differ from those in industry, and why (or why not). Also consider discussing whether or not the problem is as serious as the readings suggest.

2. Why does the military, in particular the Air Force, rely so heavily on software in modern weapons systems?

You might want to hit these points: Are we relying too much on sophisticated software? Is there an alternative to our highly software intensive systems? Try to avoid the temptation to get into a generic "high-tech vs low-tech" debate, but focus on the specific attributes software gives systems (intelligence, flexibility, adaptability, etc.).

3. What are the costs of building and fielding software-intensive weapon systems?

In this discussion, try to identify some of the penalties we pay for software-dependent systems: high cost, delivery delays, unpredictable "bugs" in performance [e.g.-that the initial F-16's couldn't use their navigation/flight computers in Death Valley, because they were flying below sea level. The computer hadn't been programmed to accept that as a flight parameter!]], difficulties in making upgrades, etc.

4. Do the benefits of highly-complex and software-intensive systems offset the costs?

This discussion can be short: "yes" vs "no", but try to avoid that. Try to enumerate and compare the benefits you discussed earlier and the costs you just discussed and make a rational "value" judgement on those benefits and costs.

5. Does it make sense for the Air Force to write its own software? What are the implications and ramifications of having someone else do so?

Here, try to draw on expertise in the room if any exists in software development. Try to identify the benefits of in-house programming (on-call availability, dedication to AF schedule for systems, low management risk [an AF activity won't go bankrupt],

consistency in practices, etc.) and the costs (recruiting costs, retention problems [in the face of lucrative civilian jobs], job satisfaction challenges, training costs, overhead burden that doesn't ease when workload does, and stagnation without external innovation). Contrast the two and see if there is a consensus on whether it makes sense or doesn't to do programming in-house. Though there obviously isn't a "right" answer, your group may come to the conclusion that the optimum solution is a mix of in-house and civilian out-of-house programming.

WRAP-UP:

Conclude this session by reemphasizing the following:

Computers are everywhere, and we spend a lot of money on them. We have them only to help us fly, fight, and win, and if they aren't doing that, something is wrong.

Software is a problem of enormous cost and complexity. We rely on it for all of our major weapon systems, and we aren't doing a good job of delivering it on time.

As senior leaders, we must be able to manage our resources--computers and software included--efficiently.

This faculty guide prepared by Lt Colonel Bernie Skoch, AWC Class of 1990.

COMPUTER ISSUES FOR SENIOR LEADERS

TERM **

COURSE (**)

6****

ADVANCED STUDY

PERIOD *

1. INTRODUCTION: Computers are pervading the Air Force. Over the past five years, the Air Force has spent over \$17 Billion dollars on them. Are we getting our money's worth? Some in Congress think not, and the Service is getting lots of attention because of that. And small computers are now in use in large numbers in AF units worldwide. Why do we have all of these systems? How did we end up with what we have? Why don't we buy Macintosh computers? This course will explore those issues. It will provide a senior leader with the knowledge needed to better define automation requirements, to understand how systems are acquired, and to better use the systems now in, and planned to be in, the Air Force. It will also explore the software "problem" that is affecting weapon systems costs, delivery schedules, and operation.

2. OBJECTIVE: There are seven objectives for students of this course:

a. Analyze the pervasiveness of automation systems in the Air Force, why it exists, and what the costs and benefits of it are.

b. Analyze the pervasiveness, criticality, and problems associated with software-intensive weapon and support systems in the Air Force.

c. Analyze how requirements for automation systems are developed, defined, and translated into on-line systems.

d. Analyze legislative and contractual environment in which the Air Force and other Services must acquire their automation systems, and how that environment affects their approach to acquiring systems.

e. Analyze the history of requirements contracts and how they are applied to meeting automation needs.

f. Analyze the concept of information architecture, and its significance to information management and automation in the Air Force.

g. Analyze the future of automation technology, in particular as it relates to Air Force needs.

3. TEXT MATERIALS: To be determined.

4. INSTRUCTOR: Staff members of the Standard Systems Center (Gunter AFB), the Bold Stroke course, and the AU Deputy Chief of Staff for Communications-Computer Systems.

5. REPRESENTATIVE TOPICS:

The Importance of Computers in the Air Force
The Software Problem
Requirements--What Are They?
Standard Automation Systems
Command and Control Systems
Mission Support/MAJCOM Systems
Requirements Contracts (Especially Small Computers)
MAJCOM/Base-Level Automation Systems and Support
Information Architecture
The Future of ADPE Technology

6. CLASSIFICATION: Unclassified

7. WORKLOAD: 45 minutes-1 hour preparatory reading per session

8. EVALUATION: A 5-7 page analytical essay on a pertinent automation or software topic.

9. DEPARTMENTAL SPONSOR: DFX

10. NOTE: This course is designed for students not familiar with automation issues. Accordingly, students in (or recently in) the 49XX career field (communications-computer systems) should not enroll.